

# **SEAREY POWER BUSS**

## **INSTALLATION MANUAL for SEAREY AMPHIBIAN AIRCRAFT**

P/N 2075B SeaRey

SPECIFICATION IP-2075B-SeaRey

REV. 1

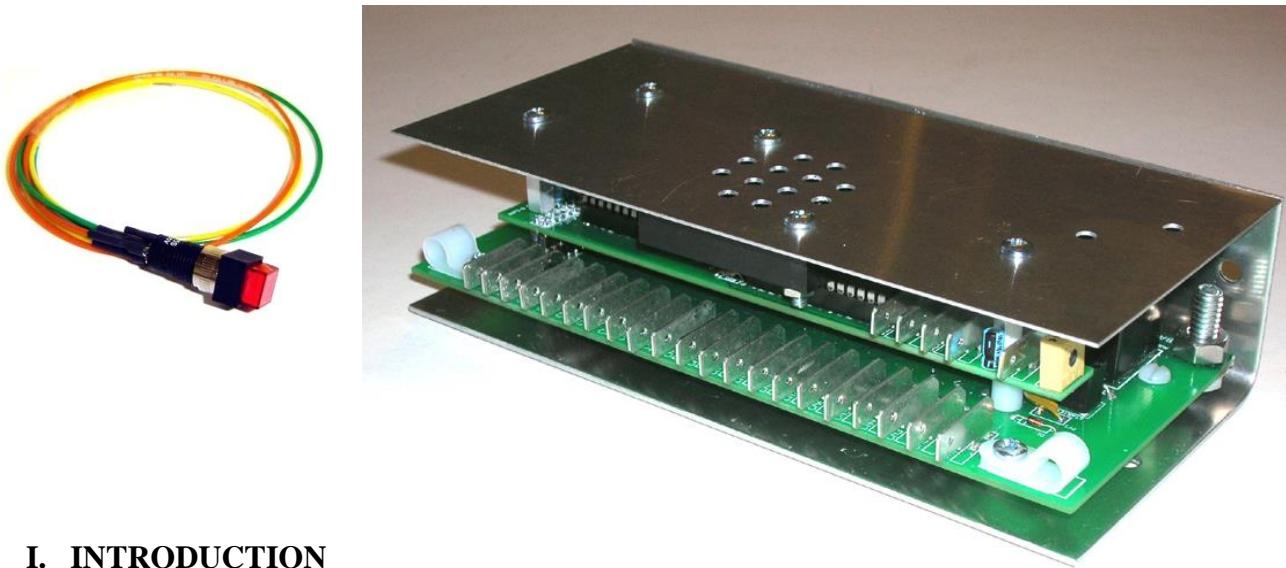
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Approved

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**For Experimental Category Aircraft Only. Not FAA Approved**



## I. INTRODUCTION

This manual provides information for installing and operating the SeaRey Power Buss electronic circuit protection system on a SeaRey or similar experimental aircraft. All installation work should be performed in accordance with this manual and applicable sections of AC 43.13 - 1B.

## II. SYSTEM DESCRIPTION

The SeaRey Power Buss is an electronic device that provides 12 volt DC overload monitoring and protection for 18 electrical circuits. The Power Buss also monitors (high amperage) generator supply and landing gear actuator circuits.

Protection is provided by 18 solid-state PTC ("Positive Temperature Coefficient") current limiters (trade name POLYSWITCH®) that, like circuit breakers and fuses, automatically remove power when a circuit becomes overloaded. Just as mechanical circuit breakers can be reset, the PTC can be reset, but only if power to the PTC or the load (or service) supplied by the PTC is manually shut off for approximately 15 seconds.

Monitoring is provided by a red warning light (that also includes the function of a momentary push switch) and an electronic voice annunciator system that provides an audio identification of the tripped circuit through the pilot's headset and an optional speaker.

The SeaRey Power Buss includes a protected avionics buss that automatically removes power from sensitive avionics systems during engine start. Although there is provision for an avionics master switch, the integral power-down function reduces this requirement.

**External 40 Amp Alternator Protection:** The red warning light and voice annunciator system also monitors the system voltage. If voltage exceeds 16v for a period of 10 sec, the high voltage cutout circuit will cut off power to the alternator regulator control circuit and shut down the 40 amp external alternator.

An optional system feature automatically turns off power to the external alternator regulator control circuit any time the master switch is turned off. This installer-selectable option can replace a split master switch function that ensures that the left regulator control switch is off

whenever the right battery master switch is off. These features are not applicable to the Rotax internal generator or regulator.

Weighing only 13 oz. and self-contained, the Power Buss module can be mounted anywhere behind the panel with only the warning light visible in the cockpit. The system's 18 PTC's provide an economical replacement for heavy circuit breakers. The sophisticated electronic audio alert system removes the requirement for a separate (difficult to read and interpret) circuit display module. On power up the SeaRey Power Bus automatically tests all circuits. Pressing the red warning light also tests the system and provides a "Test OK" annunciation.

The SeaRey Power Buss provides the following annunciations for eighteen on-board protected and monitored circuits plus two off-board monitored (only) high amperage circuits:

CIRCUIT TYPE	ANNUNCIATION	PTC Size (4)	Wire Size (3)	Remarks
<b>EXTERNAL CIRCUITS</b>	"Generator"	n/a		external circuit breaker required
	"Landing Gear"	n/a		external circuit breaker required
<b>SPECIAL CIRCUITS (4)</b>	"Buss One"	7 amp	20	switched by Master Relay
	"Buss Two"	7 amp	20	switched by Master Relay
	"Regulator"	5 amp	22	switched by Split Master Switch
<b>SWITCHED CIRCUITS</b>	"Panel Lights"	5 amp	22	aircraft lighting
	"Strobes"	7 amp	20	aircraft lighting
	"Nav Lights"	7 amp	20	aircraft lighting
	"Landing Lights"	11 amp	18	aircraft lighting
	"Bilge Pump"	5 amp	22	other systems
	"Trim"	5 amp	22	other systems
	"Heater"	5 amp	22	other systems
	"Flaps"	5 amp	22	other systems
	"Fuel Pump"	5 amp	22	other systems
<b>AVIONICS BUSS (1)</b>	"GPS"	5 amp	22	avionics systems
	"Intercom"	5 amp	22	avionics systems
	"Transponder"	5 amp	22	avionics systems
	"Gear Alert"	5 amp	22	avionics systems
	"Radio"	7 amp	20	avionics systems
	"Aux Avionics"	7 amp	20	avionics systems
<b>SYSTEM TEST (2)</b>	"Test OK"	n/a		push power buss warning light
<b>HIGH VOLTAGE TRIP</b>	"High Voltage"	n/a		indicates a high voltage cutout

**Important notes concerning the above table:**

1. The Avionics Bus may have its own switch or it can be set to 'always on' by means of a jumper to a convenient ground.
2. The Power Buss Warning Light must be held for up to 2 seconds to initiate the System Test.
3. a. This is the smallest wire size (gauge or AWG) that the PTC will protect in a wire bundle. (The PTC will protect larger wire sizes.) AC43.13-1B may require a larger wire size to reduce voltage drop in long circuits and to reduce heat in large wire bundles.

- b. ACI assumes that the smallest wire size will be #22. If the installer chooses this size it must have additional support, contain at least 19 strands and be bundled together with at least three other #22 wires or a wire(s) of greater strength.
  - c. Some PTC's such as "Buss One" and "Buss Two" will power more than one low-amp service. Always size each wire to the PTC, not to the amperage of the low-amp service. As these two Busses have 7 amp PTC's, all wires to their lower amp services must use at least #20 gauge wire.
4. To facilitate a reset without tripping the main power breaker and/or turning off the master relay, Bus One and Bus Two should each have an emergency reset switch reachable from the cockpit.
5. PTC current limiters and thermal circuit breakers are both activated by the thermal heating that occurs when they carry currents greater than the rated. The actual time it takes for either device to trip is dependent on the peak current. For example, a PTC fuse rated to hold 5 amps continuously may conduct 10 amps (200% rated capacity) for 100 seconds before tripping and 20 amps (400%) for 5 seconds before tripping. A typical 5 amp thermal circuit breaker exhibits a similar characteristic by conducting 10 amps (200% rated capacity) for about 40 seconds and 20 amps (400%) for 3 to 5 seconds before tripping. Although PTC and thermal breakers function well in protecting circuits from ground shorts it is prudent to take into consideration the intermittent nature of some circuits and to allocate PTC current limiters close to the expected current draw on the circuit.

### **III. SYSTEM OPERATION**

The following explanation applies to operation of the SeaRey Power Buss when powered by aircraft battery, 20 amp engine generator or an optional alternator. The operation is the same whether on the ground or airborne. When directed to press and hold the red Power Buss Warning Light (PBWL) you should hold the light pressed until you receive the desired response.

#### **When first powered up:**

- a. The Power Buss automatically checks all Buss-monitored circuits. If a PTC or a (monitored) circuit breaker has removed power from a circuit the Power Buss will illuminate the PBWL and repeat the name of the tripped circuit every 2.5 seconds.
- b. To cancel the voice message, push the PBWL & hold it until the light momentarily turns off indicating that the voice has been canceled. When you release the switch, the light will illuminate again indicating that the circuit is still tripped.
- c. If more than one circuit has been tripped, the voice message for the next warning will automatically sound after the previous message has been canceled. When all the tripped circuits have been identified and the voice messages canceled, the warning light will remain illuminated until such time as all tripped circuits are recovered.
- d. You can replay the tripped circuit warnings at any time by pushing the PBWL. The voice message for each circuit that has tripped will play once in sequence. If no circuits have tripped, the voice message "TEST OK" will be heard indicating that the system is functioning and there are no warnings. The system should be tested in this fashion prior to flight.

**Flight Operations:**

- a. Airborne annunciation and operation of the SeaRey Power Bus is identical to the “first power up” description. However, multiple tripped circuits are very unlikely.

**Recovering a failed circuit:**

- a. Before attempting to recover any tripped circuit the cause for the overload should be determined and removed. If airborne, consideration should be given to completing the flight without attempting to recover the circuit.

**Warning:** Do not make repeated in-flight attempts to recover tripped circuits.

- b. The PTC remains tripped by a small current “leaking” through the device keeping it warm. Circuit recovery requires either the removal of power to the PTC or removing the load (or service) supplied by the PTC for approximately 15 seconds. For switched circuits simply turn the switch ‘OFF’ for 15 seconds and then, if necessary, turn the switch ‘ON’.

- c. With an optional 40 amp alternator installed, if a high voltage trip has to cut off power to the alternator field circuit thus stopping current from the alternator, the system can only be reset by turning the master switch off and back on (removing and then reapplying power to the Power Buss.)

**Warning:** If airborne, do not remove power from the Power Buss if this action will shut down a service(s) critical for flight.

#### **IV. APPLICABILITY**

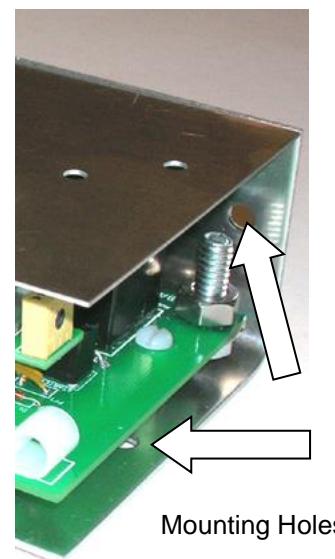
This system is **not FAA approved**. It is intended for installation on **Experimental** category aircraft only. The aircraft must meet the following minimum requirements for an installation.

- a. 12 volt DC power.
- b. The aircraft generator or alternator must be current-rated to a maximum of 40 amps.
- c. The aircraft should have an audio panel, intercom or VHF transceiver with an unswitched audio input..
- d. External master relay, switches breakers etc. as indicated on the wiring diagram (pages 10 and 11)
- e. For the purposes of this manual, references to “generator” refer to the internal Rotax 20 amp “integrated generator”. References to “alternator” refer to an optional “external 40 amp alternator”. References to “regulator” refer to the Rotax external Ducati “rectifier-regulator”.

## V. COMPONENT INSTALLATION AND WIRING

### Power Buss Module and Warning light:

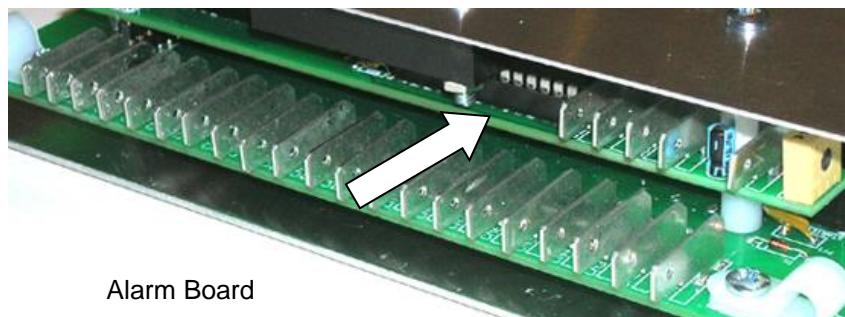
The Power Buss module is supplied with a mounting bracket. It should be mounted in a location free from exposure to adverse vibration, high temperatures and water. The Power Buss module must not be mounted to, or within 12 inches of any fuel line or fuel tank. The module can be mounted in any attitude. The red Power Buss Warning Light (PBWL) with integral switch should be mounted through the instrument panel in a location that is within the pilot's peripheral vision and within easy reach with seat harness attached. The color-coded wires are connected to the Alarm Board at terminals CN24, CN25 and CN26 (see page 8). Prior to installing these wires you can check for continuity from the green 'switch' wire to the orange 'ground' wire when the PBWL is pressed. Do not apply 12 volts to the wires. After installation, if the PBWL fails to illuminate for a tripped circuit it is possible that the LED contacts are reversed. Try swapping the orange and yellow wires.



Mounting Holes

### Wiring General:

The Power Buss module has two circuit boards. The larger "Buss Board" has 22 male spade terminals. The smaller "Alarm Board" has 5 male spade terminals. The male spade terminals are 0.25" wide and 0.032" thick.



Alarm Board

The installer should provide female push-on connectors such as AMP P/N 640903, 05, 07 according to the correct wire size per AC 43.13-1B. Female spade connectors should have adequate insulation to prevent any possibility of a loose connector shorting against a nearby terminal. All wires (Tefzel insulated type) should be bundled and secured to prevent movement against each other. The heavy battery, generator or alternator power wires should end in  $\frac{1}{4}$ " ring terminals and be secured to the Buss Board terminal post with the supplied lock washer and nut.

**Note:** Place the lock washer on top of the ring terminal (not directly on the circuit board.) Secure these heavy wires through the on-board nylon "P" clip and then provide stress relief by securing off-board.

**Warning:** Make certain that heavy-cable battery leads are always connected to the correct battery terminal. A reversed-polarity error may damage the Power Buss circuitry.

The installer must provide a master relay (master solenoid or master contactor) between the aircraft battery and the Power Buss. The installer must provide a circuit breaker(s) between the integrated generator (or optional 40 amp alternator) and the Power Bus terminal post.

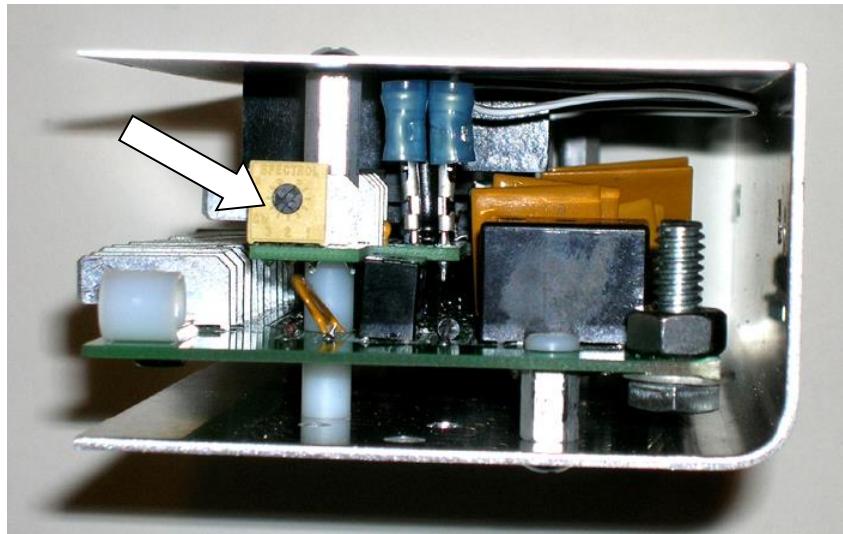


**Note:** Starter solenoids draw high currents and therefore should be powered directly from the master relay. Any service that draws more than 11 amps must have a separate off-board circuit breaker and be powered directly from the master relay or via the high current “Battery” terminal on the Buss Board.

The installer is responsible for providing adequate DC switches for all switched circuits. To facilitate a reset (without tripping the main power breaker and/or turning off the master relay) Buss One and Buss Two should each have a reset switch reachable from the cockpit. These reset switches are “normally ON” (the circuit is opened to reset the PTC) and located where they will not be accidentally be turned OFF. A momentary (normally closed) toggle or momentary push button “off” switch rated for 5 amps would be ideal for this purpose.

### Adjustable Audio:

The warning annunciation output level is adjustable via a small pot on the Alarm Board. This adjustment only controls the level on CN27 Warning Audio, to the headset (not the optional Power Buss speaker.) As the audio pot should be set to a comfortable level during System Checkout (below) and then tested over several flights to achieve an optimum setting.



Audio Pot Location

### Wiring the Avionics Buss:

In order to protect sensitive radios etc. from power surges during engine start it has been common practice to install a switch that can remove power from an aircraft's avionics bus.

The SeaRey Power Buss has an on-board relay that will automatically power-down its on-board Avionics Buss (and the six avionics circuits) when the starter solenoid is energized. To implement this automatic sequence a wire must be connected between the starter switch “S” terminal that powers the starter solenoid coil and Power Buss spade terminal CN2 (see wiring schematic on pages 10 & 11.)

If the Avionics Buss is set to automatically power-down on engine start you may wish to dispense with an avionics switch. This option requires that the on-board relay be continuously closed by running a wire from Power Buss spade terminal CN1 to any convenient ground.

If you wish to retain an avionics switch you must run a wire from Power Buss spade terminal CN1 to your avionics switch and then to ground so that when the switch is ‘ON’ spade terminal CN1 is grounded.

**Note:** Retaining an Avionics Buss switch in the aircraft would facilitate resetting a tripped avionics PTC without having to remove power from the SeaRey Power Buss.

**Note:** Switching the Avionics Buss ‘OFF’ has no effect on the circuit monitoring system. The electronic voice annunciator will only alert if there is a tripped PTC.

## **Wiring the External 40 Amp Alternator (not applicable to the 20 amp internal generator):**

This feature is installer selectable and can be ignored if desired. (A Cessna Split Master Switch wired to ensure that the regulator control circuit is not energized when the battery master switch is turned off will accomplish the same feature.) There is an additional connector next to CN21. It is labeled MCI for "Master Cutoff Interface". This connector is factory-connected to CN21 by a wire jumper soldered between them. If you want to use the Auto Alternator Cutout, you need to cut this jumper wire and then connect the MCI terminal to the ground lead between the master switch and the master solenoid. Now, when you turn on the master switch, you apply a ground to MCI. This energizes a Power Buss relay that allows power to go to the regulator circuit of the 40 amp external alternator. If you turn off the master this removes the ground from MCI, de-energizes the relay, and cuts off power to the regulator circuit. (The factory-installed jumper keeps the relay energized through CN21.)

## **Monitoring the Two Off-board Circuit Breakers:**

The SeaRey Power Buss can monitor the two high-amperage off-board circuit breakers protecting the Generator supply and Electric Gear circuits. Before installing this function, check that the heavy gauge wires are connected as indicated in the schematic on page 10 or 11.

**Warning:** Do not connect high amperage wire to a Power Buss circuit board spade terminal.

To implement Generator circuit monitoring a light gauge (22 AWG) wire must connect Power Buss spade terminal CN23 to the same terminal on the generator circuit breaker that connects heavy gauge wire to the Rotax voltage regulator or B+ on the optional 40 amp alternator.

**Note:** If the Rotax integrated generator and an optional 40 amp alternator are both supplying power only one supply circuit breaker can be monitored.

**Note:** If off-board Gen. Breaker monitoring is not implemented, 12v must be applied to CN23.

To implement Gear circuit monitoring a light gauge (22 AWG) wire must connect Power Buss spade terminal CN22 to the same terminal on the gear actuator circuit breaker that connects heavy gauge wire to the gear actuator (the downstream side.)

**Note:** If off-board Gear Breaker monitoring is not implemented, 12v must be applied to CN22.

## **Power Buss Circuit Board Connections:**

In order to identify a terminal, both the Alarm and Main Buss circuit boards are etched with the adjacent terminal's number or name.

## **Alarm Board and Warning Light Connections**

CN22	Gear Actuator (breaker)		Connect to gear actuator terminal (downstream side) of external circuit breaker.
CN23	Generator (breaker)		Connect to alternator/generator terminal of external circuit breaker. (Terminal that connects to the regulator or alt. B+)
CN24	Warning Light (switch)		Connect to the <b>green</b> wire of the PBWL.
CN25	Warning Light (light)		Connect to the <b>yellow</b> wire of the PBWL.
	Warning Light (ground)		Connect the <b>orange</b> wire of the PBWL to ground. (This is not an Alarm Board connection.)
CN26	Warning Audio (out)		Connect to a non-mutable headset jack, audio panel or vhf.

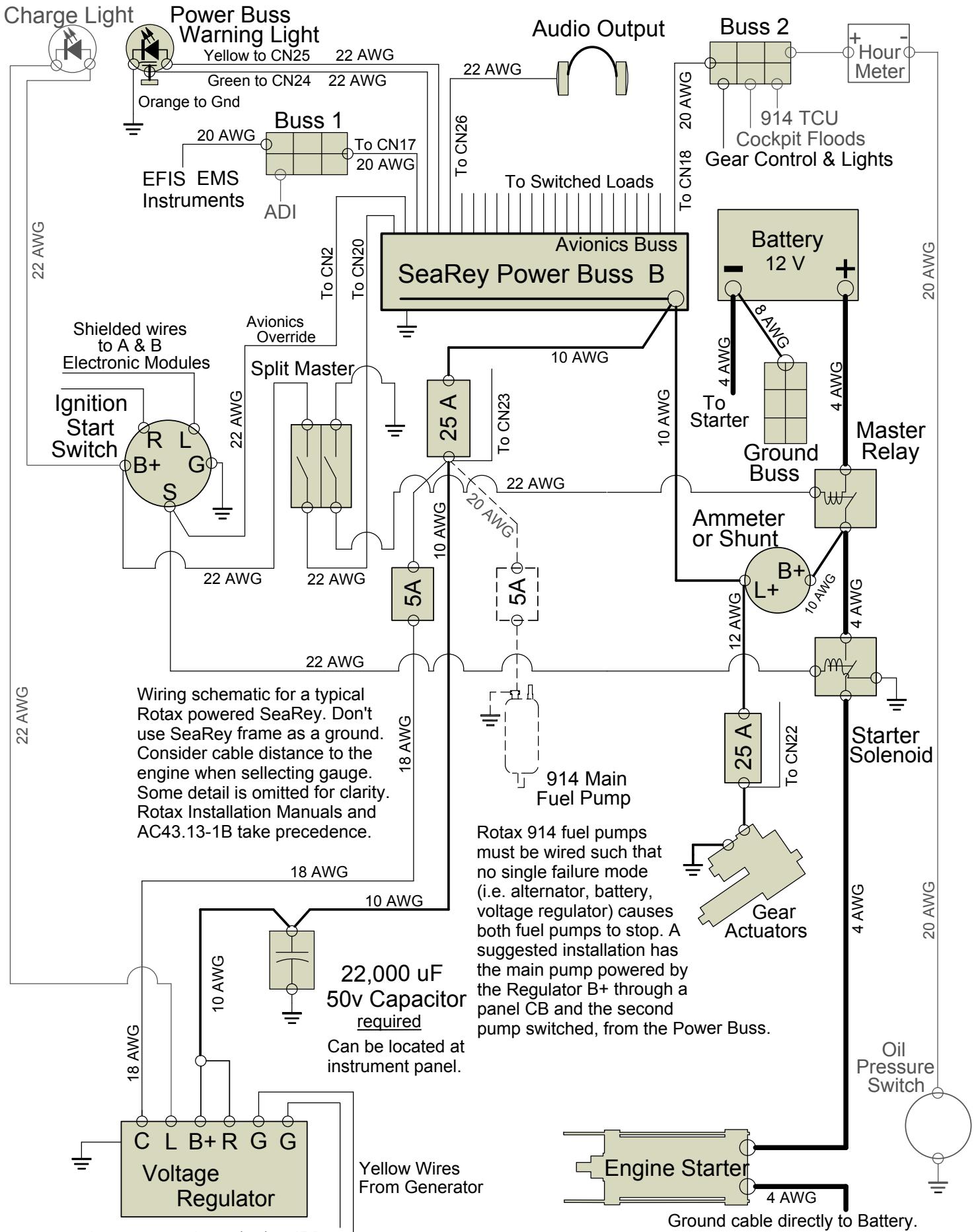
## Main Buss Board Connections

Bat/Gen	Heavy terminal post <sup>1</sup> (on end of Buss Board)		Connect heavy gauge wires from Master Relay and from Generator CB or Alternator CB.
CN1	Avionics Master (onboard relay)		Connect directly to ground (no avionics master switch) or connect to ground through an avionics master switch.
CN2	Avionics Override (shuts down avionics)		Connect to the Starter Switch "S" terminal that powers the starter solenoid coil.
CN3	Aux Avionics (avionics buss)	7 amp	Connect to any non-specified avionics system that you wish powered down during start. (i.e. a 12v aux outlet)
CN4	Radio (avionics buss)	7 amp	Connect to VHF radio 12v power input.
CN5	Gear Alert (avionics buss)	5 amp	Connect to Gear Alert 12v power input.
CN6	Transponder (avionics buss)	5 amp	Connect to Transponder 12v power input.
CN7	Intercom (avionics buss)	5 amp	Connect to Intercom 12v power input.
CN8	GPS (avionics buss)	5 amp	Connect to GPS 12v power input.
CN9	Bilge Pump (switched)	5 amp	Connect to Bilge Pump switch (provides 12v power.)
CN10	Panel Lights (switched)	5 amp	Connect to Panel Light switch/dimmer (provides 12v power.)
CN11	Strobes (switched)	7 amp	Connect to Strobe or Beacon switch (provides 12v power.)
CN12	Nav Lights (switched)	7 amp	Connect to Navigation Lights switch (provides 12v power.)
CN13	Fuel Pump <sup>2</sup> (switched)	5 amp	Connect to Fuel Pump switch (provides 12v power.) (see Rotax 914 note below.)
CN14	Heater (switched)	5 amp	Connect to Heater Fan switch (provides 12v power.)
CN15	Flaps (switched)	5 amp	Connect to Flap actuator switch (provides 12v power.)
CN16	Trim (switched)	5 amp	Connect to Trim switches (provides 12v power.)
CN17	Buss 1 (non-switched)	7 amp	Connect to Master Buss 1 (provides 12v power.) (general buss for non-switched services like EFIS, EMS)
CN18	Buss 2 (non-switched)	7 amp	Connect to Master Buss 2 (provides 12v power.) (general buss for non-switched services like Gear Control.)
CN19	Landing Lights (switched)	11 amp	Connect to Landing Lights switch (provides 12v power.) (Two H3 55 watt halogen lights draw about 8 amps at 14v.)
CN20	Regulator (switched)	5 amp	Connect to left split master switch or Start Switch "B+" terminal. Provides 12v to External 40 amp Alternator field "IG"
CN21	Power Buss Ground		Connect to convenient battery ground. (Grounds Power Buss internal circuitry.)
MCI	Master Cutoff Interface		(Normally jumpered to CN21) For auto generator cutout remove jumper and connect to Master Solenoid ground lead

<sup>1</sup>. If a 40 amp Alternator is used in parallel with the Internal Generator please refer to Rotax for appropriate wiring schematic.

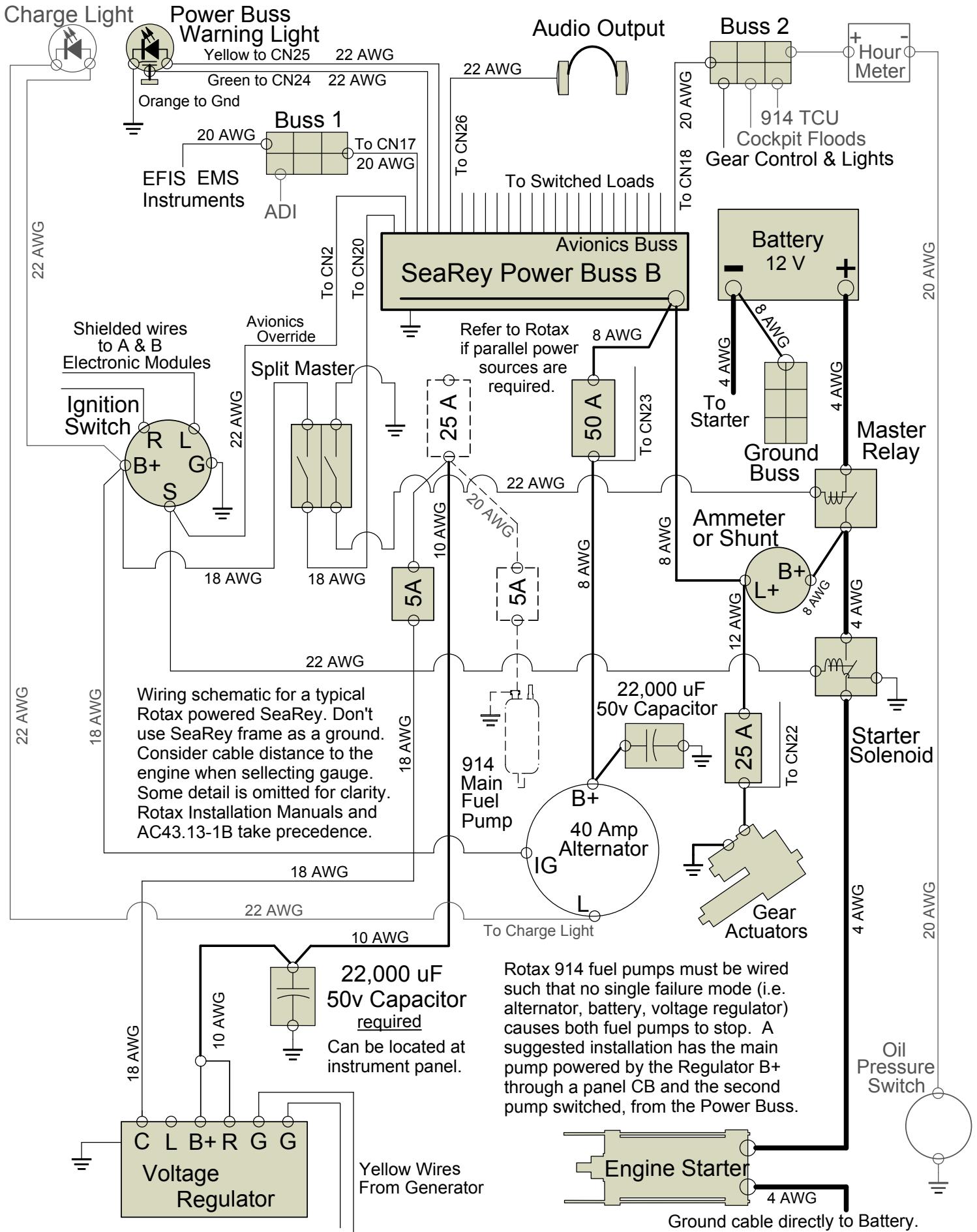
<sup>2</sup>. The Rotax 914 fuel pumps must be wired such that no single failure mode (i.e. alternator, battery, voltage regulator failure) causes both pumps to stop. A suggested installation has the main pump powered by the Regulator B+ through a panel CB (only) and the second pump switched from the Power Buss CN13.

## Suggested Wiring with SeaRey Power Buss and Internal Rotax Generator



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## Suggested Wiring with SeaRey Power Buss and External 40 Amp Alternator



*Drawing not to scale* 12/06/13 JRD

## **VI. SYSTEM CHECKOUT** ( To test the newly installed system):

- a. This test must be accomplished engine OFF. Confirm that all electrical systems are properly installed and switched ‘OFF’. Check that the generator and gear actuator circuit breakers are not manually tripped.
- b. Turn the battery master switch ‘ON’ The Power Buss should be energized by the battery and the red Power Buss Warning Light (PBWL) should remain extinguished.
- c. If the audio is wired through the VHF or intercom, turn these systems ‘ON’ (the avionics switch should also be “ON” if installed). Press the PBWL once. You should hear “Test OK” through the (optional) Power Buss speaker and your headphones.
- d. Pull the Generator circuit breaker. Once the 22,000uf capacitor loses its charge the PBWL should illuminate and the system should repeat “Generator”... “Generator”... (If necessary, bleed off the capacitor charge by temporarily grounding the heavy power supply cable from the generator or alternator.)
- e. To cancel the warning annunciation and check for other tripped circuits, press and hold the PBWL until the light extinguishes and the annunciation ceases. Release the PBWL. The red warning light should re-illuminate and the system should now repeat “Regulator”... “Regulator” (there is no power to the Regulator control circuit.)
- f. To cancel this second warning annunciation and check for further tripped circuits, once again Press and hold the PBWL until the light extinguishes and the annunciation ceases. Release the PBWL and the red warning light should remain ‘ON’ with no annunciation (the two circuit warnings have been silenced but the circuits are still unpowered.)
- g. To hear the warnings again, press the PBWL briefly. The annunciation “Generator”... “Generator” should be heard.
- h. Reset the Generator circuit breaker. The annunciation should cease and the PBWL should extinguish. (Press the PBWL and you should hear “Test OK”.)

This test may be repeated with the Gear Actuator circuit breaker pulled (as installed.) Again, there may be a short delay during testing as circuit capacitance bleeds off.. The warning for this circuit should be “Landing Gear”.

**Warning:** It is not good practice to test a circuit breaker or PTC by shorting a circuit.

Multiple tripped circuits should cause the system to sequentially annunciate another tripped circuit each time the PBWL is released after cancelling an annunciation. When the last tripped circuit annunciation is cancelled the PBWL will remain ‘ON’ until all circuits are recovered.

To test the automatic power-down feature of the Avionics Buss:

- a. Before starting the engine turn the Avionics Switch (if installed) ‘ON’ and all Avionics Buss services ‘ON’.
- b. Energize the starter switch (if desired the starter solenoid may be removed from the circuit) and watch for automatic shutdown of avionics services. (Some items such as the GPS may switch to internal batteries.)

## VII. FREQUENTLY ASKED QUESTIONS

### 1. Can I change the System annunciation and PTC rating?

Although the customer could, in principle, swap out the circuit board PTCs we do not recommend this action. However, as an extra-cost option ACI can provide this service and/or reprogram the system annunciations for the customer.

ACI will also provide a Power Buss customized to suit a specific aircraft manufacturer.

### 2. What if I require more or fewer circuits?

Fewer circuits are not a problem. Circuits that are not powered will not be monitored. Unfortunately circuit board size constraints prevent the monitoring of additional circuits.

### 3. Why doesn't the SeaRey Power Bus have an on-board Master Relay?

For safety reasons, the Master Relay (or Master Solenoid) must be as close to the battery as possible. The SeaRey Power Bus can be safely mounted more than three feet from the aircraft battery.

### 4. Why not provide onboard switches, "keep alive" and backup battery options?

Onboard switches would limit the location of the Power Buss and unduly restrict the style, spacing and location of switches. Without an onboard master relay, "keep alive" circuits are more complex and best wired (and externally fused) directly from the battery. A backup battery option requires charging and blocking diode circuitry that is already available with most EFIS, EMS and GPS systems.

## VIII. DOCUMENTATION

- a. The installer is responsible for making all logbook entries, revising weight and balance, and other documentation as required.
- b. System weight is 13 oz.
- c. Dimensions: 7.185" x 3.375" x 1.875" high, +/- 0.01".

## IX. MATERIALS

The following materials are included in the SeaRey Power Buss kit. Check all parts before beginning the installation.

- 1 x electronic module assembly P/N 2075B-1
- 1 x switch assembly P/N 2075-3
- 1 x installation manual P/N IP-2075B-SeaRey